

Evolution of Market Design in the context of Ultra High Wind Penetration



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Overview

- Irish Policy Context
- Developments in market design and wind penetration
- All Island Grid Study
- Single Electricity Market
- Recommendations for evolution of the market design in Ireland
- Conclusions

Overview

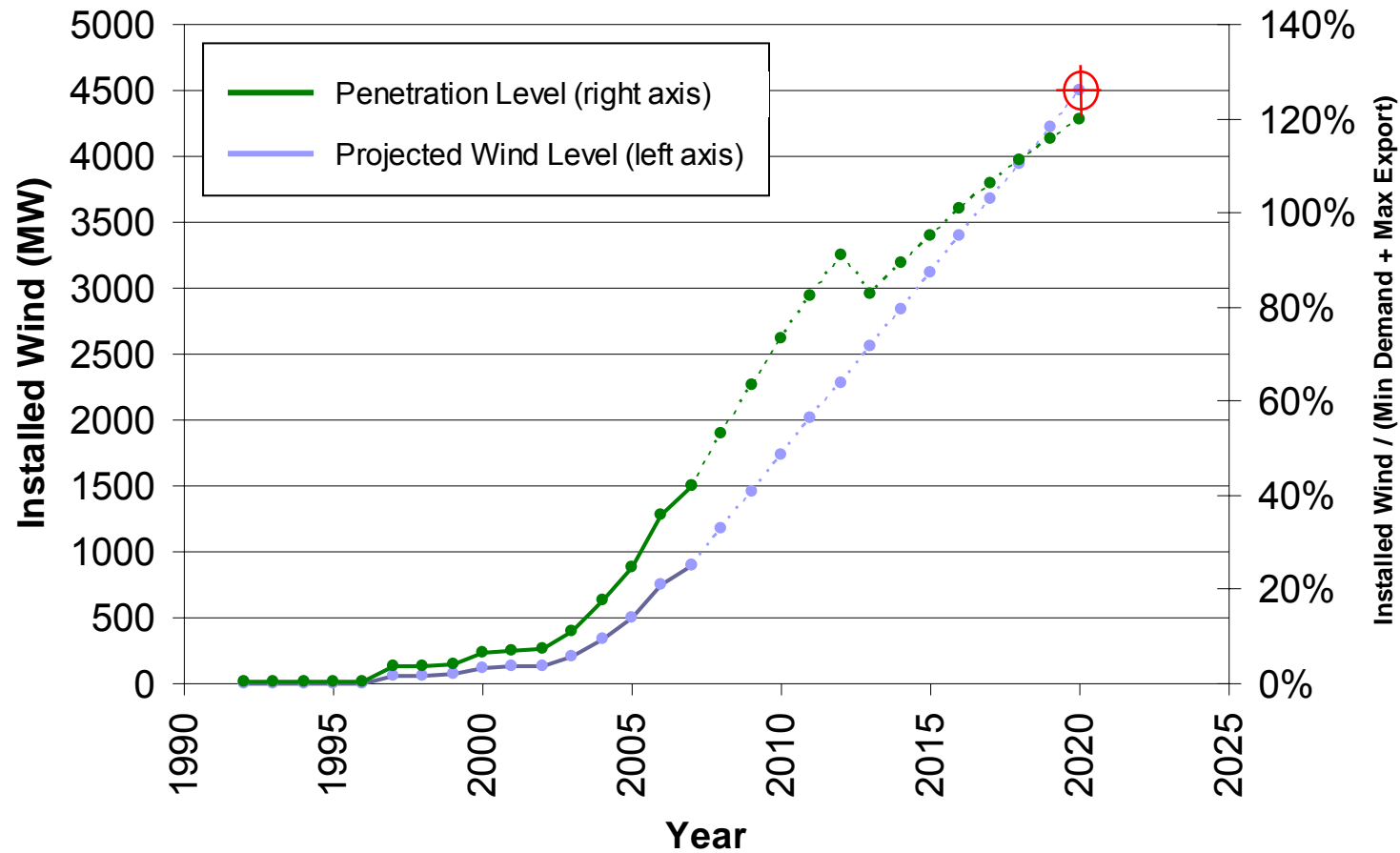
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RE Directive 2008

- Binding 2020 targets for EU states
 - 16% RE final consumption for Ireland
 - Consumption is split into Electricity (33%), Heating and Cooling (12%) and Transport (10%)
- In Ireland, 33% electricity target to met by
 - Provision of priority access and dispatch to RE
 - Development of grid infrastructure to accommodate investment in RE
 - Transparent and objective rules for charging including cost benefits of connecting renewables

Government Target (33% RE by 2020)

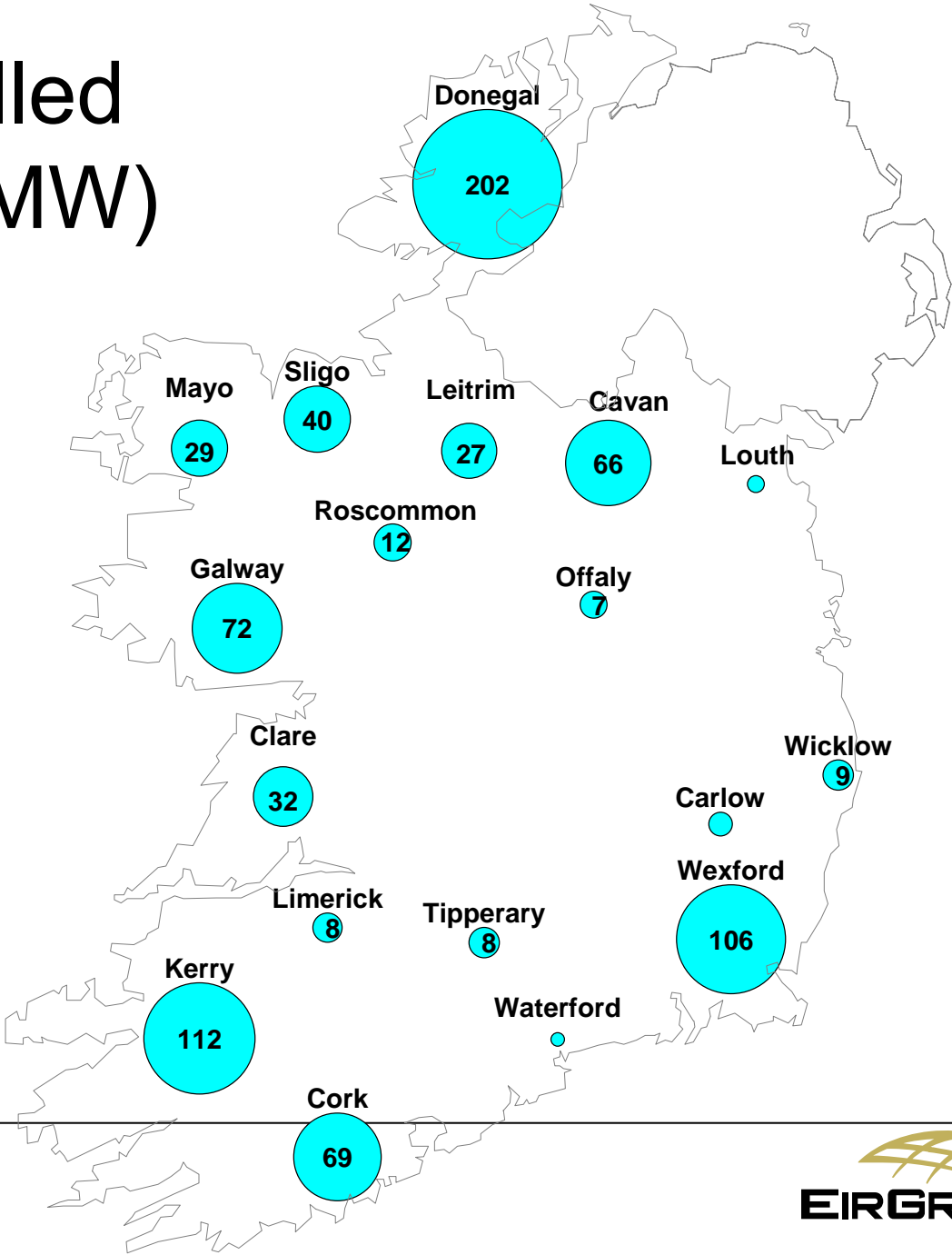
Historical and Projected Installed Wind Penetration



Irish Headlines

- What realistic renewable target should Ireland adopt?
- What level of wind penetration can be sustained – onshore/offshore?
- Can the transmission system accommodate high renewable penetration?
- Should wind be paid for curtailment?
- What support mechanism is required for wind?
- Should market rules be designed specifically to address wind?

Current Installed Wind Power (MW)



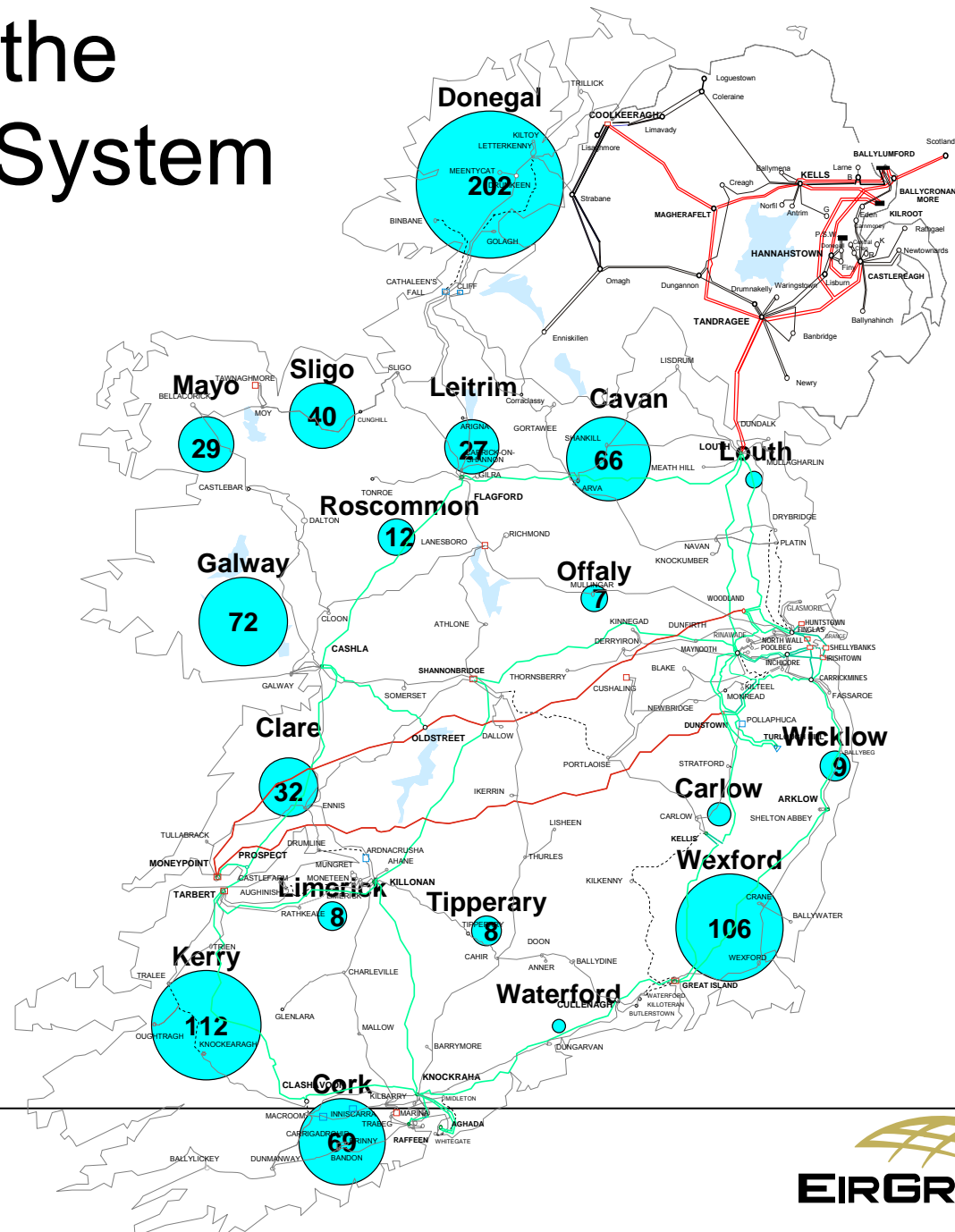
Wind and the Transmission System

Irish Transmission System

- 439 km of 400kV
- 1,822 km of 220kV
- 4,311 km of 110kV
- 165 substations

Northern Irish Transmission System

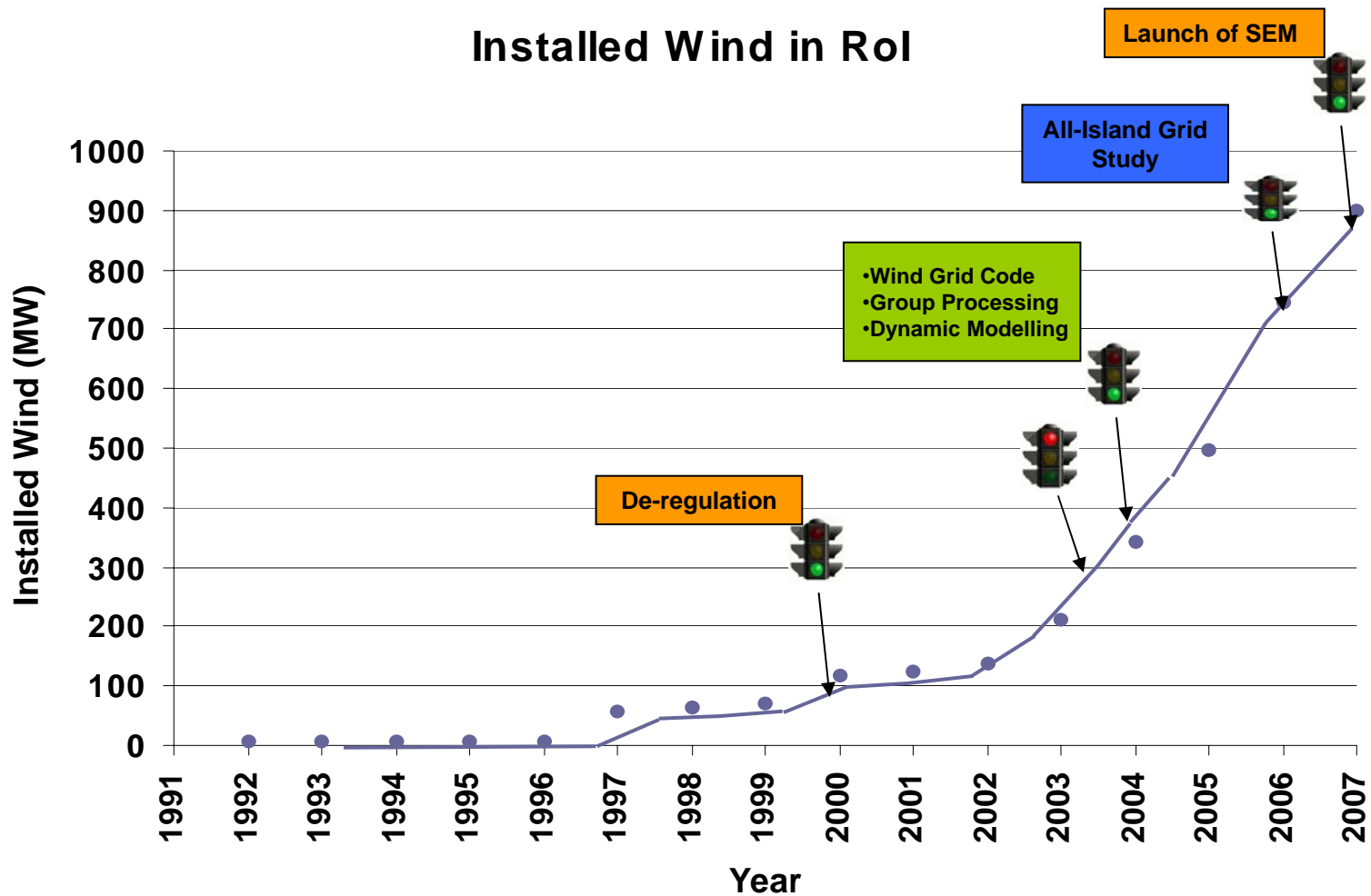
- 400 km of 275kV
- 867 km of 110kV
- 38 substations



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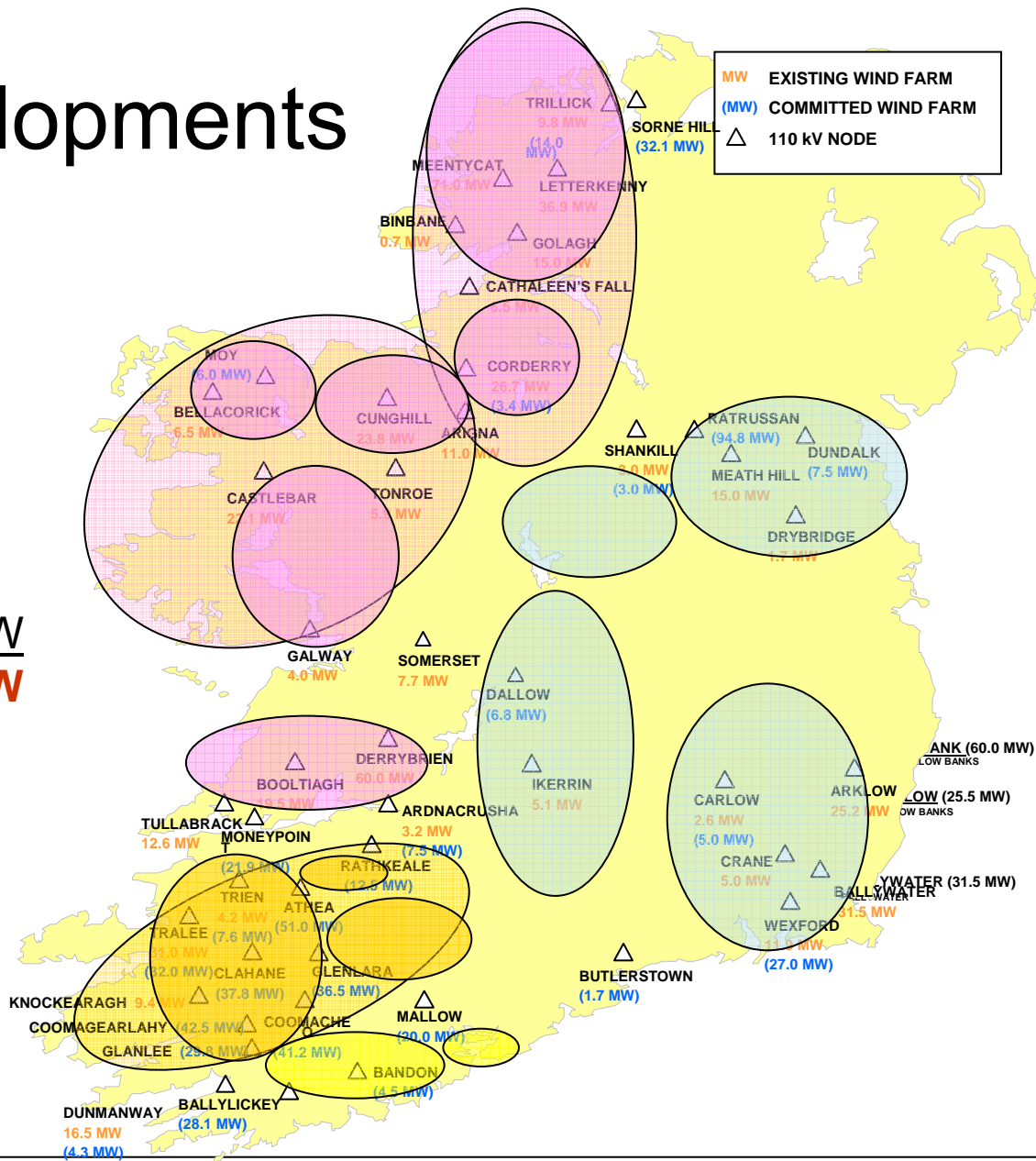
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Market and Wind Developments



Wind Developments

Connected	803MW
Contracted	762MW
Offer Process	976MW
In Queue	6523MW
Total:	9064MW



Taken from www.eirgrid.com

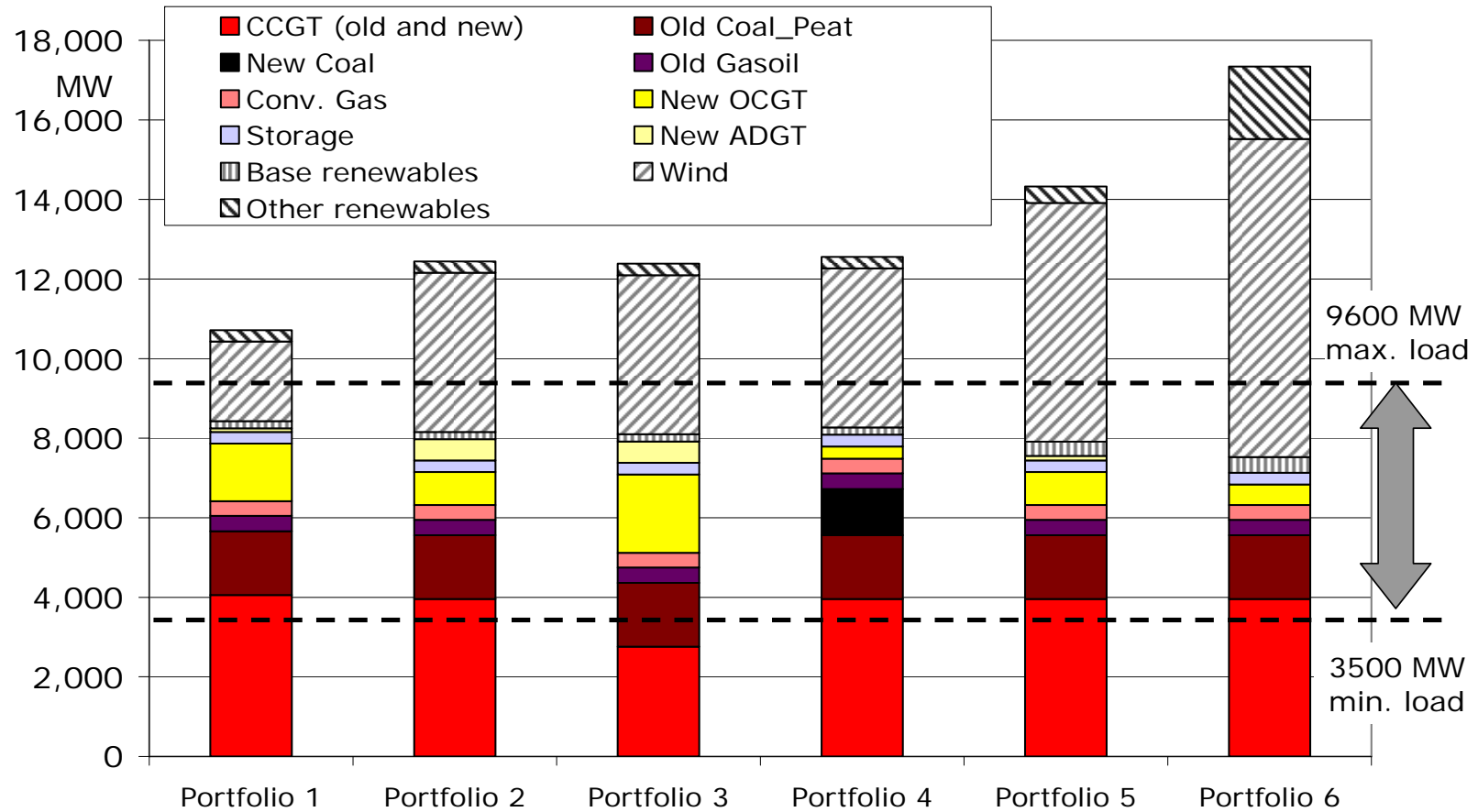


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All Island Grid Study - 2020

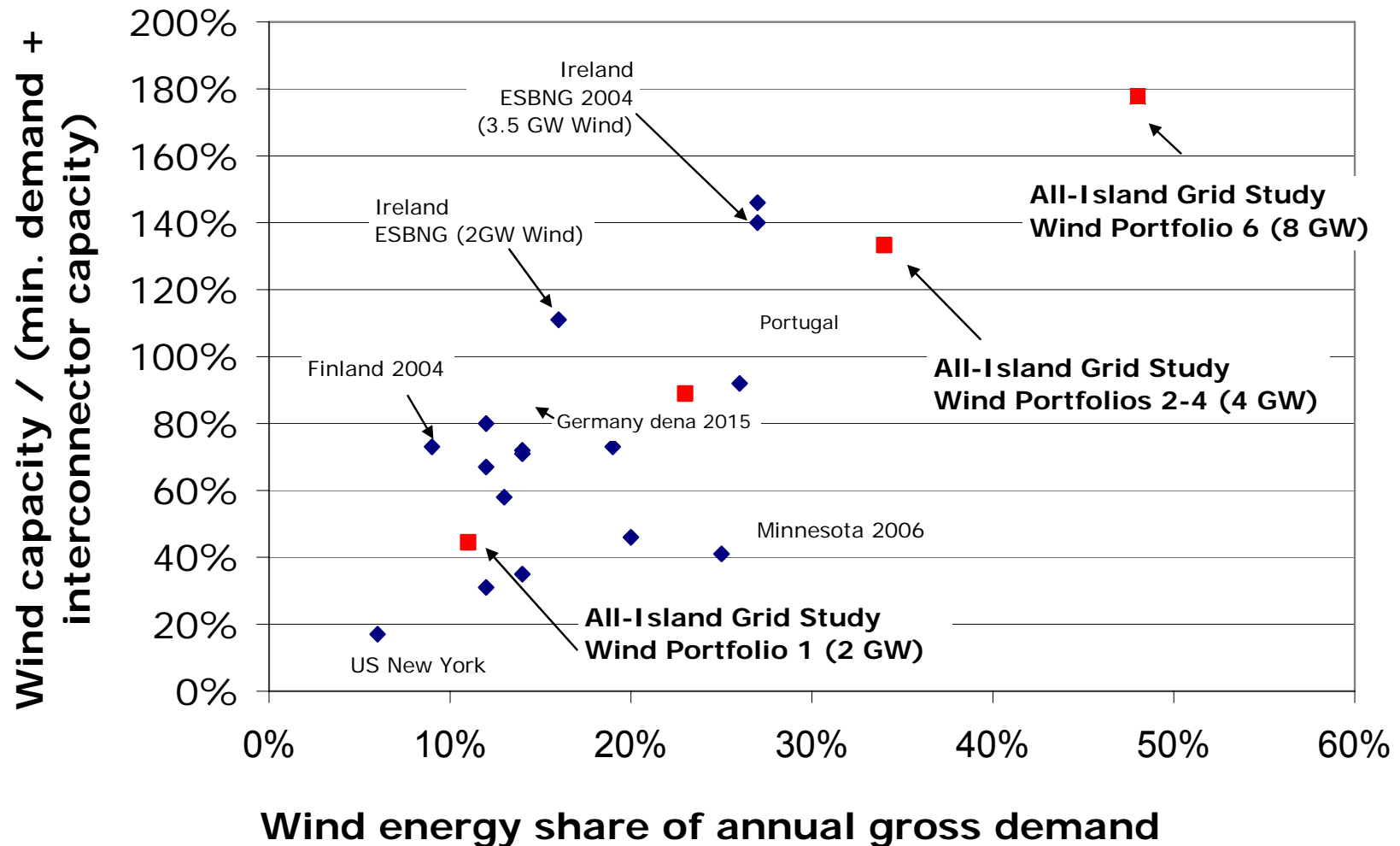
- Six portfolios of wind penetration assessed
 - Ranging from 2000MW to 8000MW
- Separate work streams
 - Portfolio Assessment
 - Resource Assessment
 - Generation variability and dispatch
 - Network analysis
 - Cost/benefit
- Market design was not addressed
 - Assumed cost based inputs with limitations



Share of Renewables

Capacity	23 %	36 %	36 %	36 %	47 %	59 %
Energy	16 %	27 %	27 %	27 %	42 %	59 %

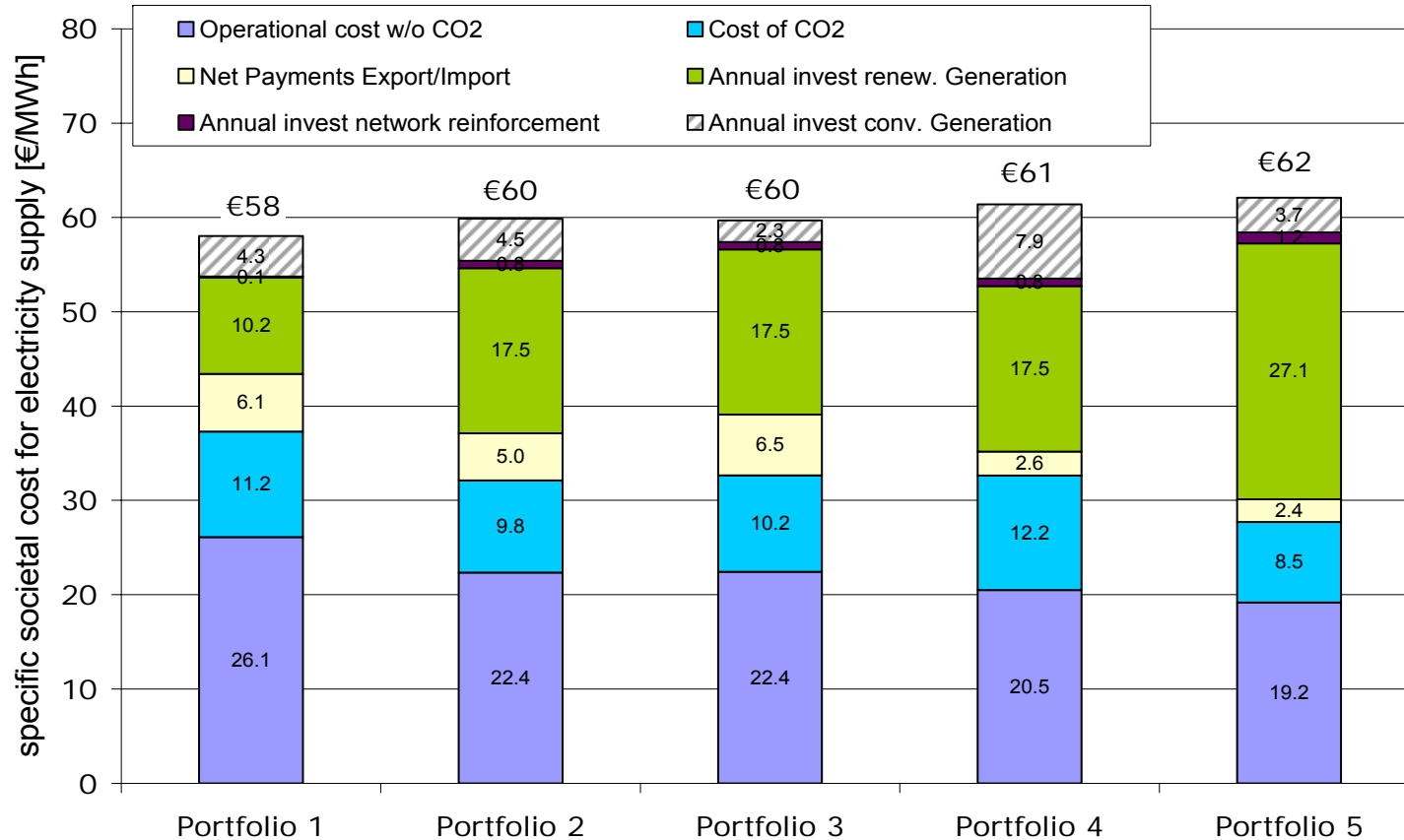
Wind Integration Studies – Comparison



All Island Study - Key Findings

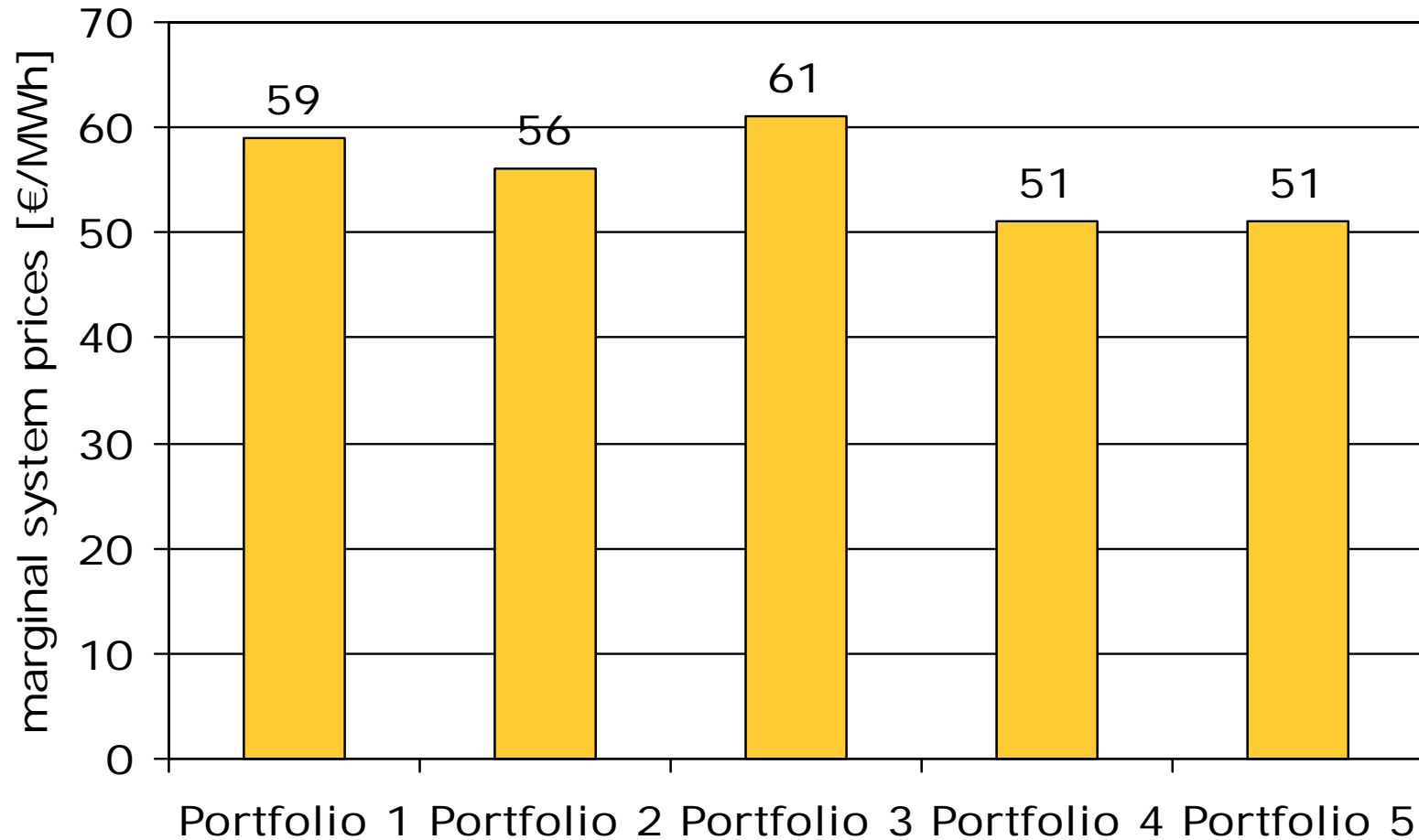
- Up to 42% RE can be accommodated
 - Subject to key assumptions
- Total cost to end users varies by 7%
 - Portfolio 1 is base-line
- Generation mix affects the average price
 - Optimum portfolio assessed
- With higher wind penetration
 - Wind is dominant fuel source
 - Total amount of imported fuels declines
 - Operating costs decrease
 - CO2 costs decrease

Total Costs



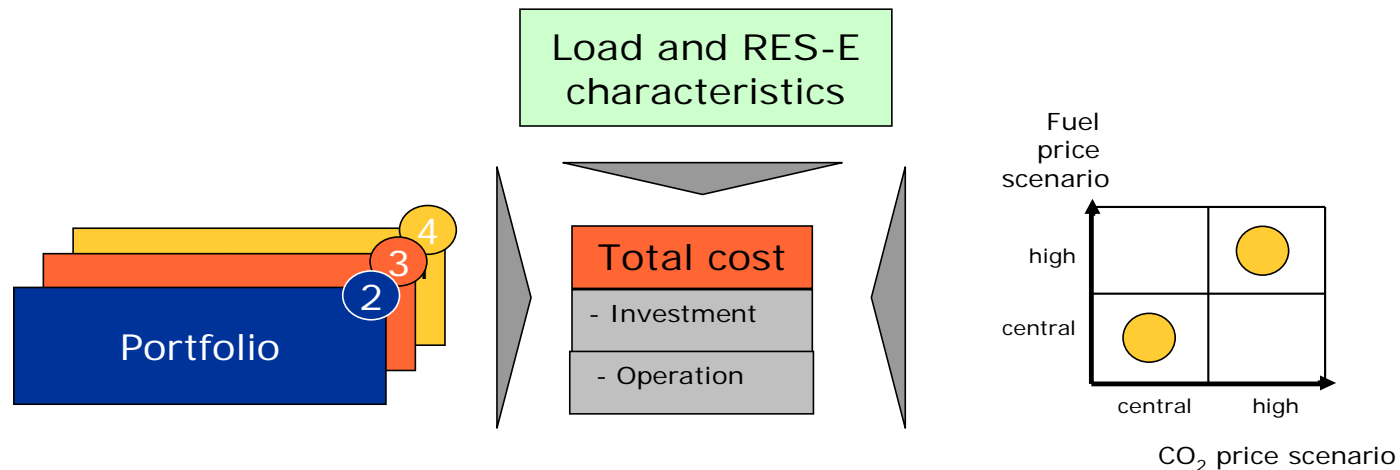
Renewable energy share	16%	27%	27%	27%	42%
CO2 emissions [Mt/a]	20	18	18	22	15

Average Prices



Optimum Plant Portfolio

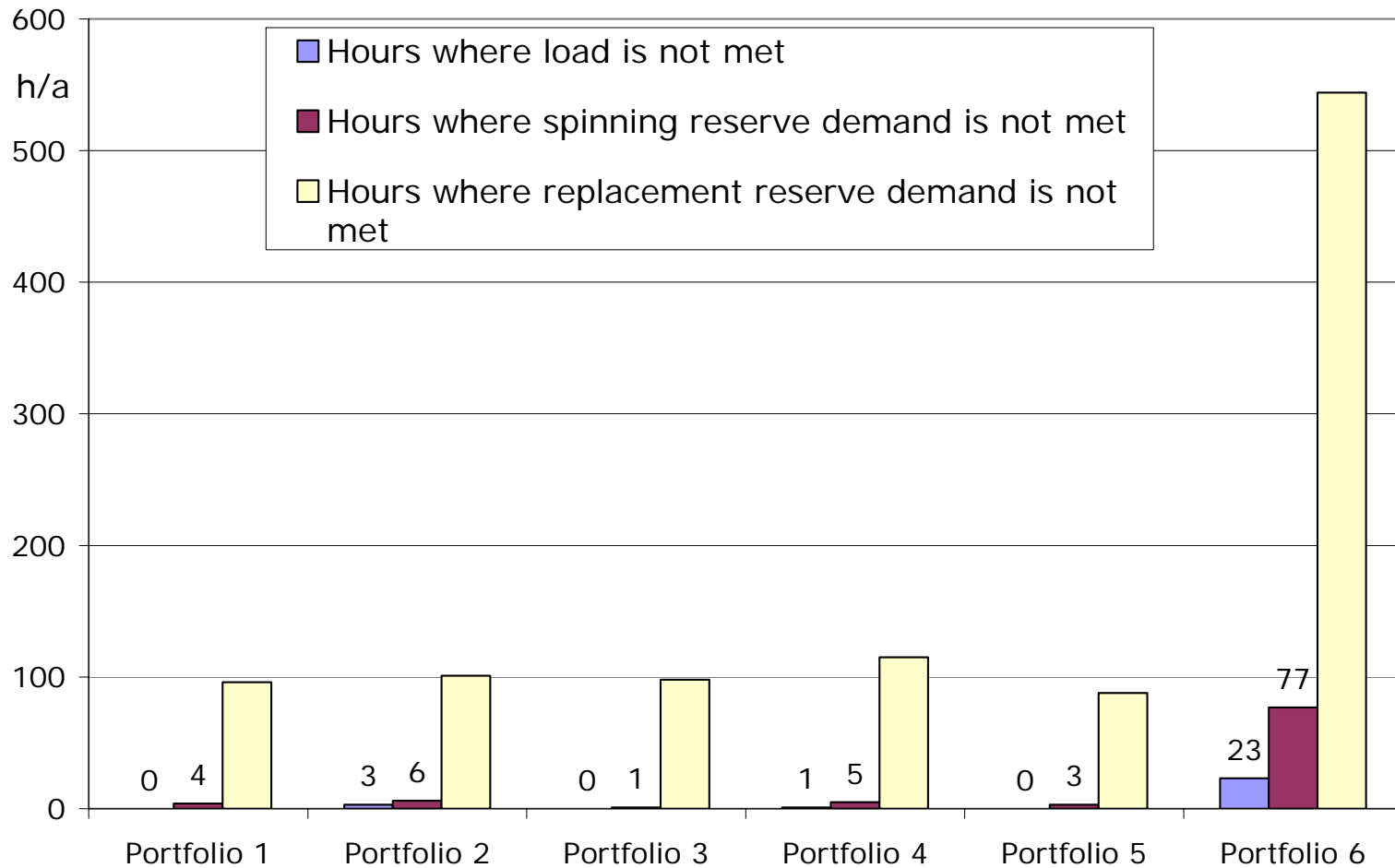
- Plant portfolio has to include enough flexible units i.e. sufficient ramp up and down rates as well as low start-up times to be able to follow the net load.



Ancillary Services

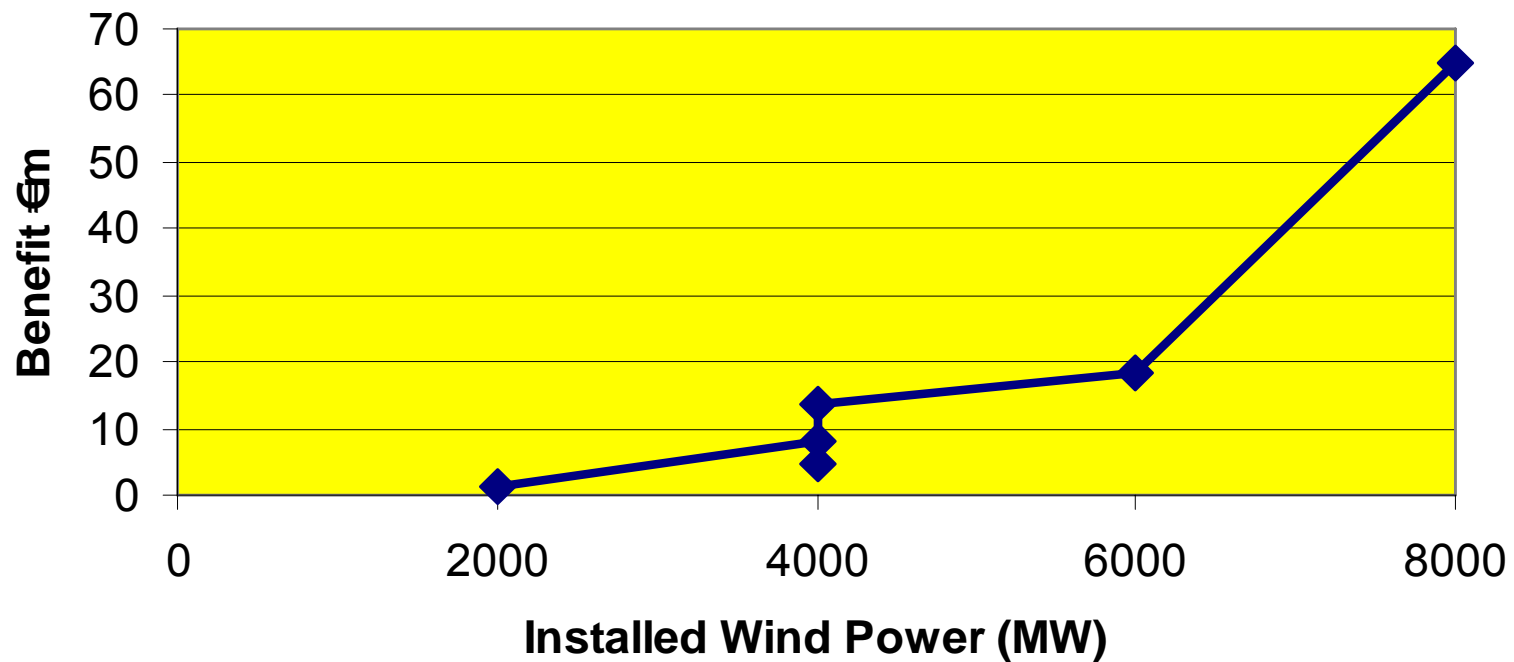
- Wind power and AS
 - Used more frequently to provide spinning reserves.
- Portfolio 3 with a high share of OCGTs shows the highest and portfolio 4 shows the lowest provision of spinning reserves
 - Hence spinning reserves is most costly in portfolio 3.
- Replacement Reserves
 - Mainly provided by OCGTs
 - Nearly the whole demand for replacement reserves is provided by off-line units

Reliability



Perfect Forecasting

Benefit of Perfect Forecasting over Stochastic Model



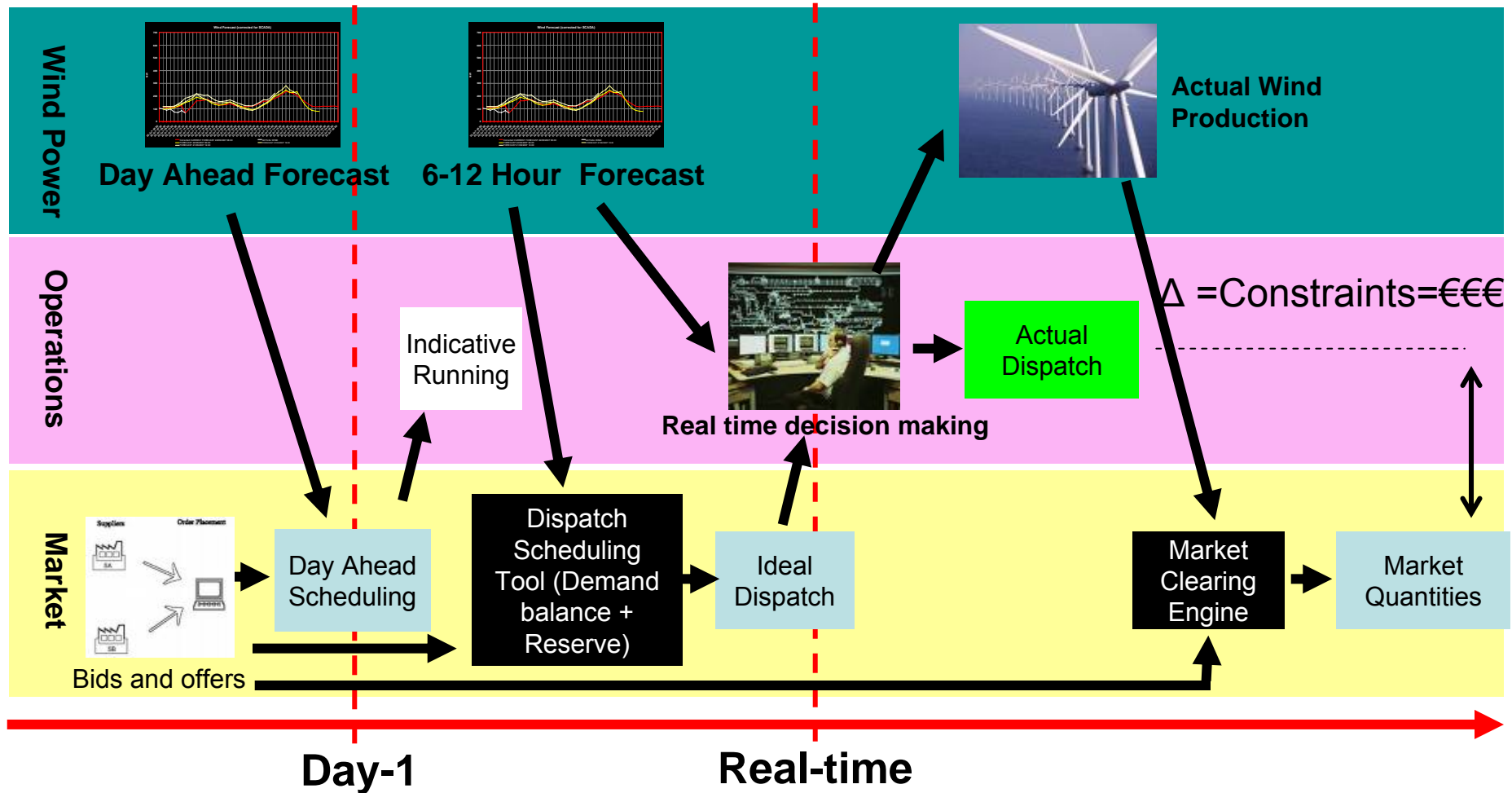
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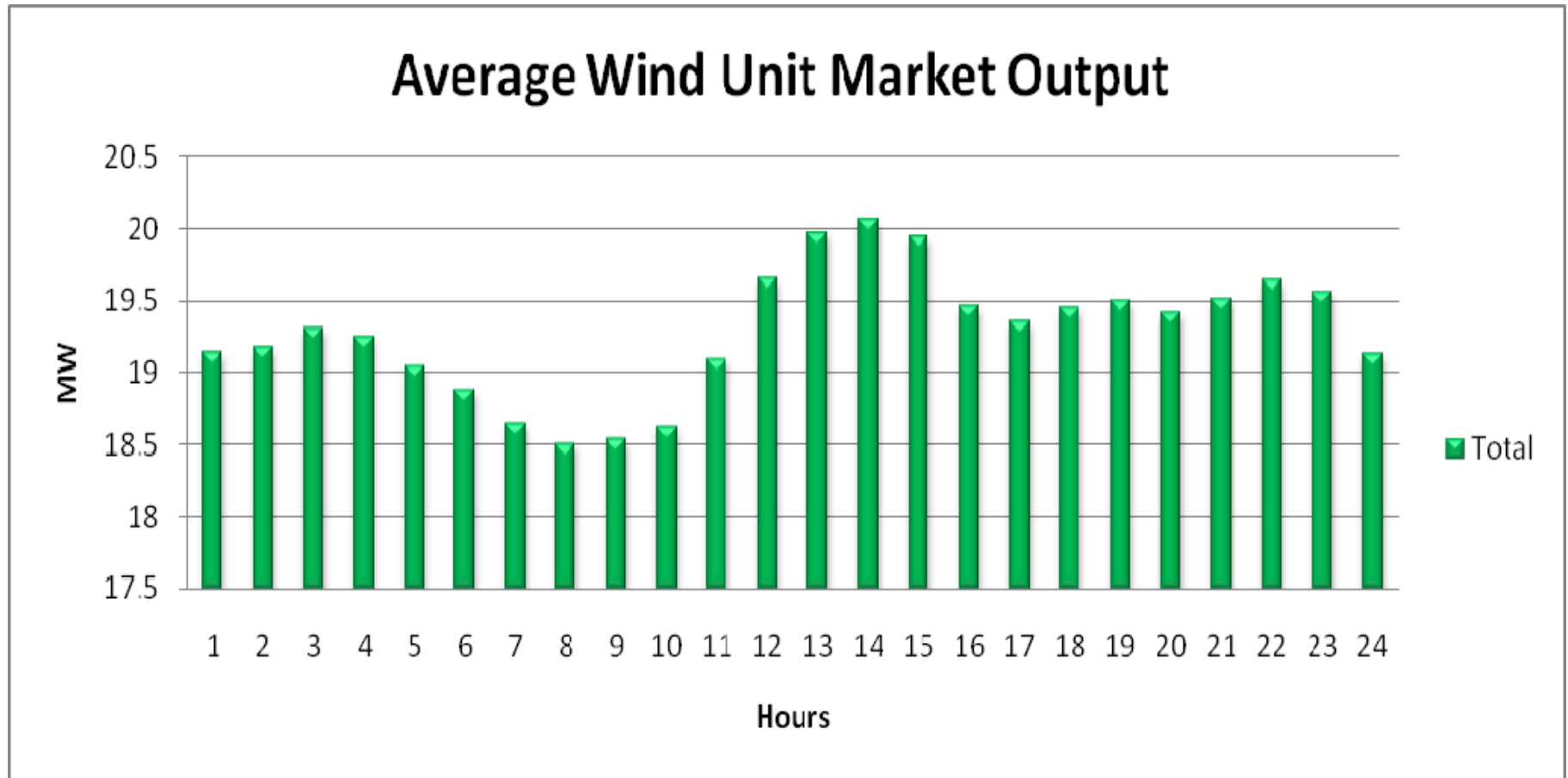
SEM Design

- Mandatory gross pool
 - Day-ahead complex bidding
 - Start up and no load costs
- Ex-post System Marginal Price (SMP)
 - Excludes transmission and reserve
- Central dispatch with constraints payments
 - Curtailment and constraints treated the same
- Capacity Payments Mechanism (CPM)
 - Ex-ante and ex-post availability payments
- Wind is treated like conventional units

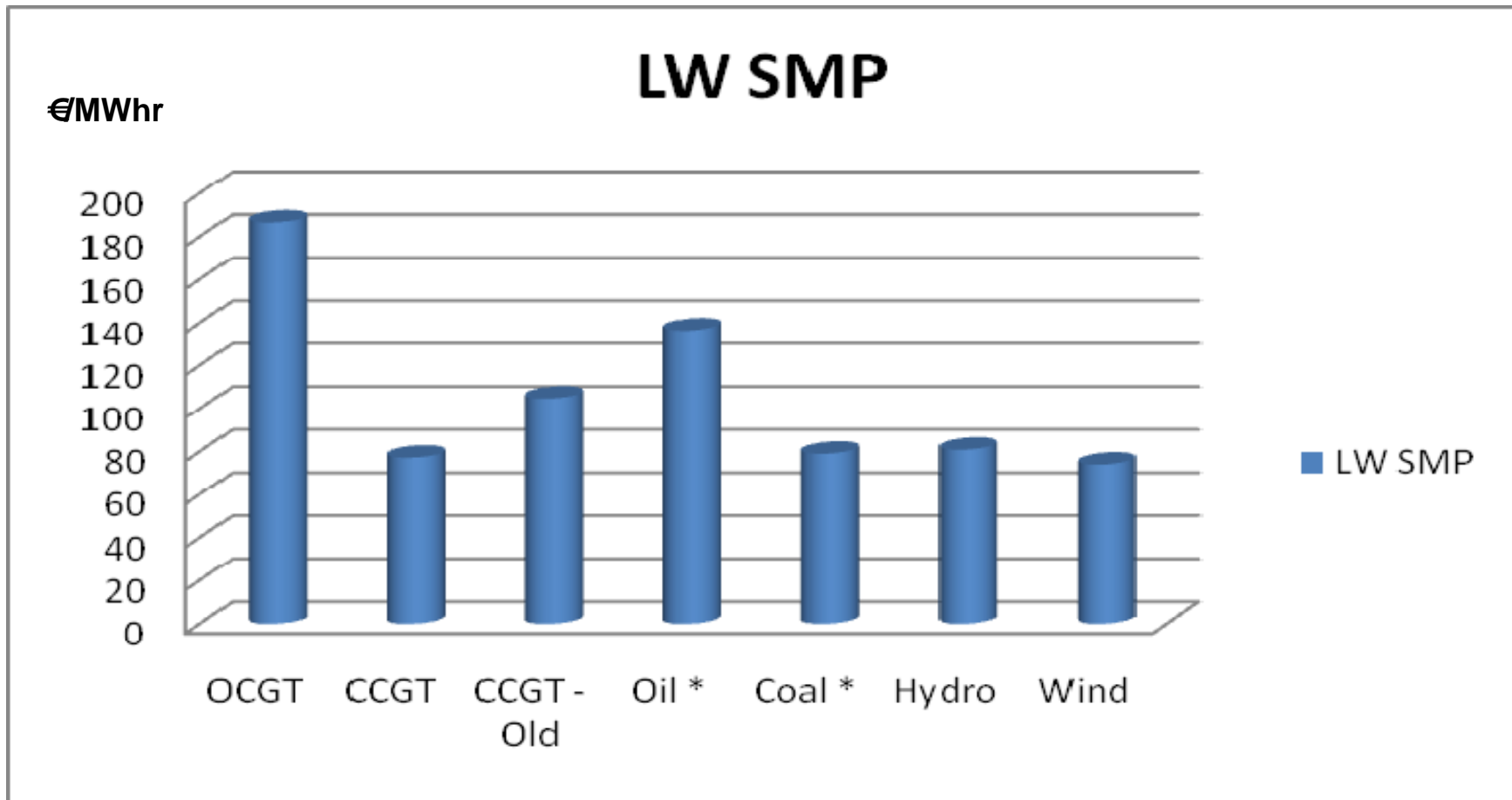
Market Process and Wind Forecasting



Wind Output - Daily



Average Load Weighted Price by Generation Type



Wind Payments in SEM

- Energy Price
 - Euro 74 per MWh of output
 - All Island Grid Study -‘average’ price of 60euro/MWh
- Capacity Payment
 - Euro 4 per installed MW wind capacity
 - 30% is paid on monthly forecast availability
- Curtailment/Constraints
 - Fully compensated for opportunity cost when dispatched down

Overview

- The Irish Situation
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How should SEM evolve?

- Pricing
 - Does SEM design reflect economic value of wind?
 - SEM energy payments includes 20-30% 'up-lift' payments
 - Regional pricing may be necessary to ensure reflection of true cost/benefit
- Reliability and Flexibility
 - Design of Ancillary Services is key
 - Short and long-term signals required for flexible plant
- Investment
 - Determine role of Capacity Mechanism in context of high wind installed
 - Investment should be focused on design of optimum portfolio
- Compensation for curtailment or constraints
 - Link payments with connection type i.e. 'firm access'
 - Policy should be transparent

Conclusions

- Market design needs to evolve
 - Promote flexibility and reliability
 - Signal optimum portfolio
- Wind should be treated similar, however
 - Need to reflect economic and operational value of wind as a resource
 - Locational signals may be required
- Difficulties will arise if wind is under/over valued

Thank you for your attention.

www.dcenr.gov.ie

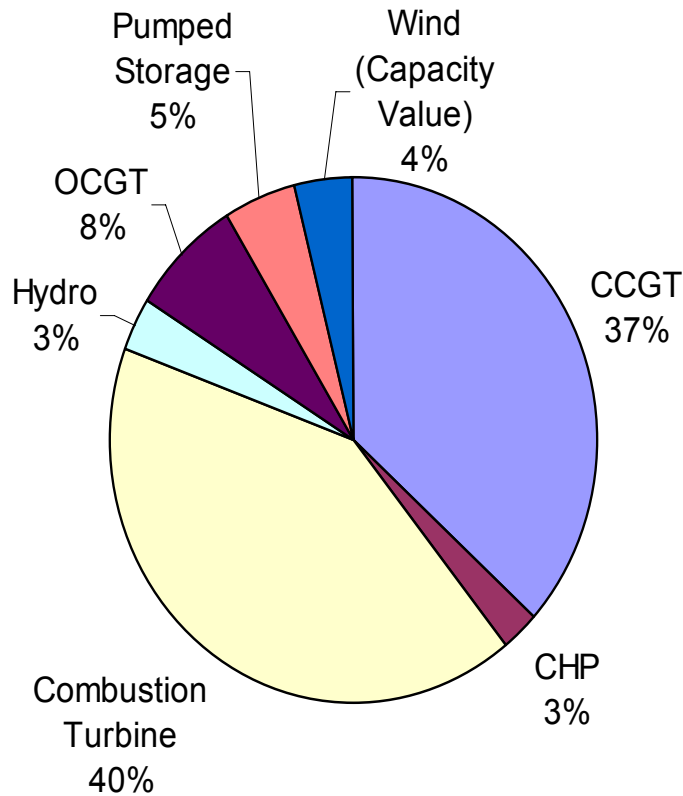
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www.eirgrid.com

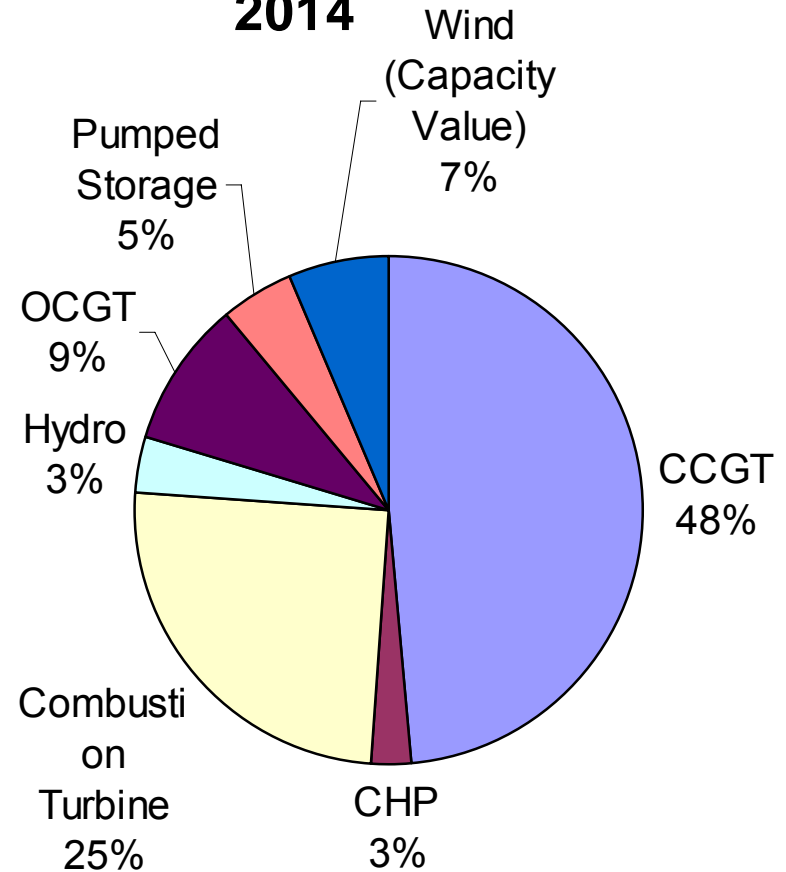
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Plant Portfolio

2008



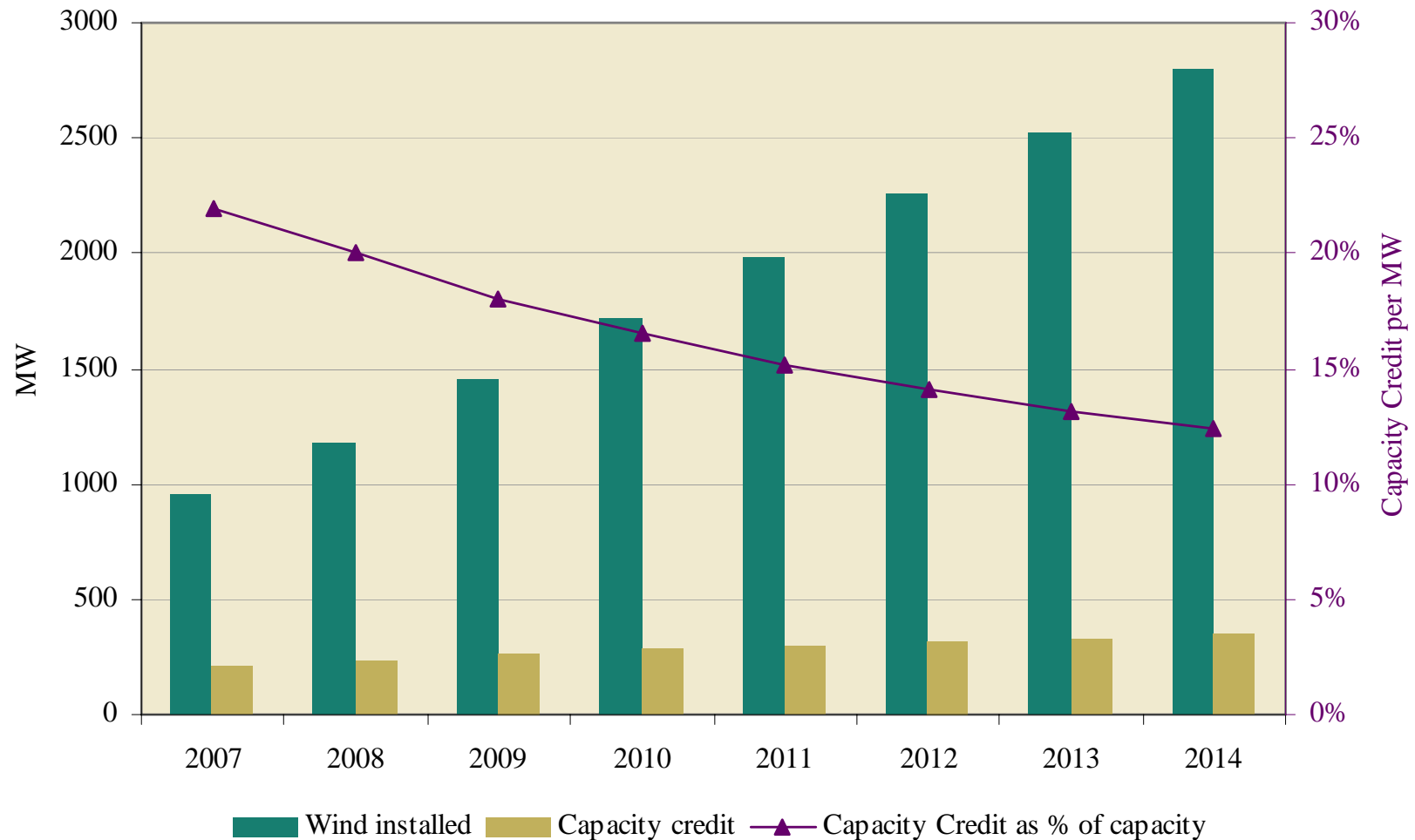
2014



Taken from the EirGrid Generation adequacy Report 2008-2014



Capacity Value of Wind



Interconnection

Inter-area Ties

- Ireland – Northern Ireland
 - 2*600 MVA (275kV AC)
 - 2*120 MVA (110kV AC)
 - Further interconnection proposed

Interconnection

- Northern Ireland – Britain
 - 500MW HVDC undersea double pole cable
- Ireland – Britain
 - 500MW HVDC link project started

